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STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION II

The Effect of Drive Produced by Propnoceptive Stimulation on Generalized Responses to Loudness and Pitch

Technical Report

No. 6

Prepared by Arnold H. Matlin

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Robert B. Zajonc, Principal Investigator

Research Center for Group Dynamics
The University of Michigan
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Soldiers Field
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Wright Patterson Air Force Base, Ohio

Armed Services Technical
Information Agency
Arlington Hall, Station
Arlington 12, Virginia

Dr. Joan Criswell
Group Psychology Branch (452)
Office of Naval Research
Washington 25, D. C.

SUMMARY

This study represented an attempt to determine the validity of the hypothesis that perceived stimulus intensity is a function of drive multiplied by the physical stimulus intensity. The effects of proprioceptive stimulation on generalization gradients along qualitative and quantitative dimensions were investigated. The findings regarding the quantitative dimension gradients were consistently opposite to what had been predicted. The predictions concerning the qualitative dimension gradients were in general confirmed. Explanations both within and outside the D x S framework were set forth to account for the significant reversal of the expected effect of drive on the quantitative dimension gradients.

INTRODUCTION

This study was carried out in an attempt to test an implication from the hypothesis set forth by Dorfman (1960) that the perceived intensity of a stimulus (S') is a function of Drive (D), Incentive (K), and the physical stimulus intensity (S). That is, $S' = f(D+K) \times S$.

This hypothesis was suggested in part by the findings that stimuli related to need-incentive states are perceived differently than neutral stimuli. Thus, Bruner and Postman (1948) and Singer (1952) report experiments concerned with the size estimate of objects bearing various symbols. In the first of these studies, Ss made size judgments of discs bearing a dollar sign as a positive symbol, of neutral discs, and of discs containing a swastika as a negative symbol. The Ss judged the positive and negative discs to be larger than the neutral ones. Similarly, in Singer's experiment, there was a significant tendency for Ss to give higher estimates of size for cards containing a "happy" face than for those containing a circle, a nonsense figure, or no figure. Bruner and Postman concluded that value, whether positive or negative, leads to perceptual accentuation. Bruner and Goodman (1947) found that children tend to over-estimate the size of coins, and that poor children do this to significantly greater degree than do rich children.

Dukes and Bevan (1952) report that jars of candy felt heavier to Ss than jars of equal weight filled with a neutral substance.

Lambert and Lambert (1953) and Lambert, Solomon and Watson (1949) found that the size of poker chips was overestimated by children when these poker chips could be used to receive candy rewards, there being less overestimation when the reward was secondary than when the reward was primary.

Related studies are those concerned with the effect upon perception of drive states within the individual. For example, Gilchrist and Nesberg (1952) observed that hunger and thirst caused pictures of food-related objects to appear brighter, while Atkinson and Walker (1956) observed that faces on pictures designed to cause need-affiliative arousal were brighter for Ss with high need-afiiliation. Nonsignificant results have been obtained however, by Dow and Gordon (1957) and Lysak and Gilchrist (1955). While these data are not entirely consistent, it seems that there are clearly some situations in which motivational effect on perception is present.

A second relevant body of data is that concerned with sensory interaction (London, 1954). In general, extraneous stimulation tends to decrease thresholds and to increase perceived stimulus intensity. For example, Gregg and Brogden (1952) found that auditory thresholds were lowered by increased light intensity.

While several explanations have been advanced to account for drive produced perceptual accentuation (Hebb, 1955; Lindsley, 1955; Bruner, 1951; and Schafer and Murphy, 1943), Lambert, *et al* (1949) argue quite appropriately that "the actual mechanism which produces overestimation...is, however, entirely obscure at the present stage of our research." Dorfman (1960) advanced an

hypothesis which attempts to explain these data within the framework of behavior theory.*

The present study is concerned with the effects of a changed drive state on stimulus generalization gradients. An implication of the D x S hypothesis in regard to stimulus generalization has been suggested by Zajonc and tested by Dorfman (1960). The S is trained to respond to a particular stimulus (CS) under a specified drive level, and then tested on the CS and on stimuli softer and louder than the CS under a different drive level. Due to stimulus generalization, each of the stimuli acquires a certain amount of generalized response strength, this amount decreasing for stimuli further from CS. Ss trained under high drive and tested under low drive, according to the D x S hypothesis, should perceive all stimuli including the CS received during testing to be less intense than the same stimuli received during training. Because of this different perception, each stimulus acquires the generalized response strength of the correspondingly less intense stimulus. The sounds heard during training which are physically more intense than the CS, when perceived during testing as less intense because of lower drive, obtain the generalized response strength of stimuli closer to the CS. Thus, their response strength is increased. The CS, and sounds physically smaller than the CS, when perceived during testing as less intense because of even lower drive, obtain the generalized response strength of stimuli even further from the CS.

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*For detailed account of the hypothesis see Technical Report #5. We shall refer to it as the "D x S hypothesis."

Thus, their response strength is decreased. The final result is to shift the generalized response curve in the direction of the larger stimuli. This result is shown diagrammatically in Figure 1.

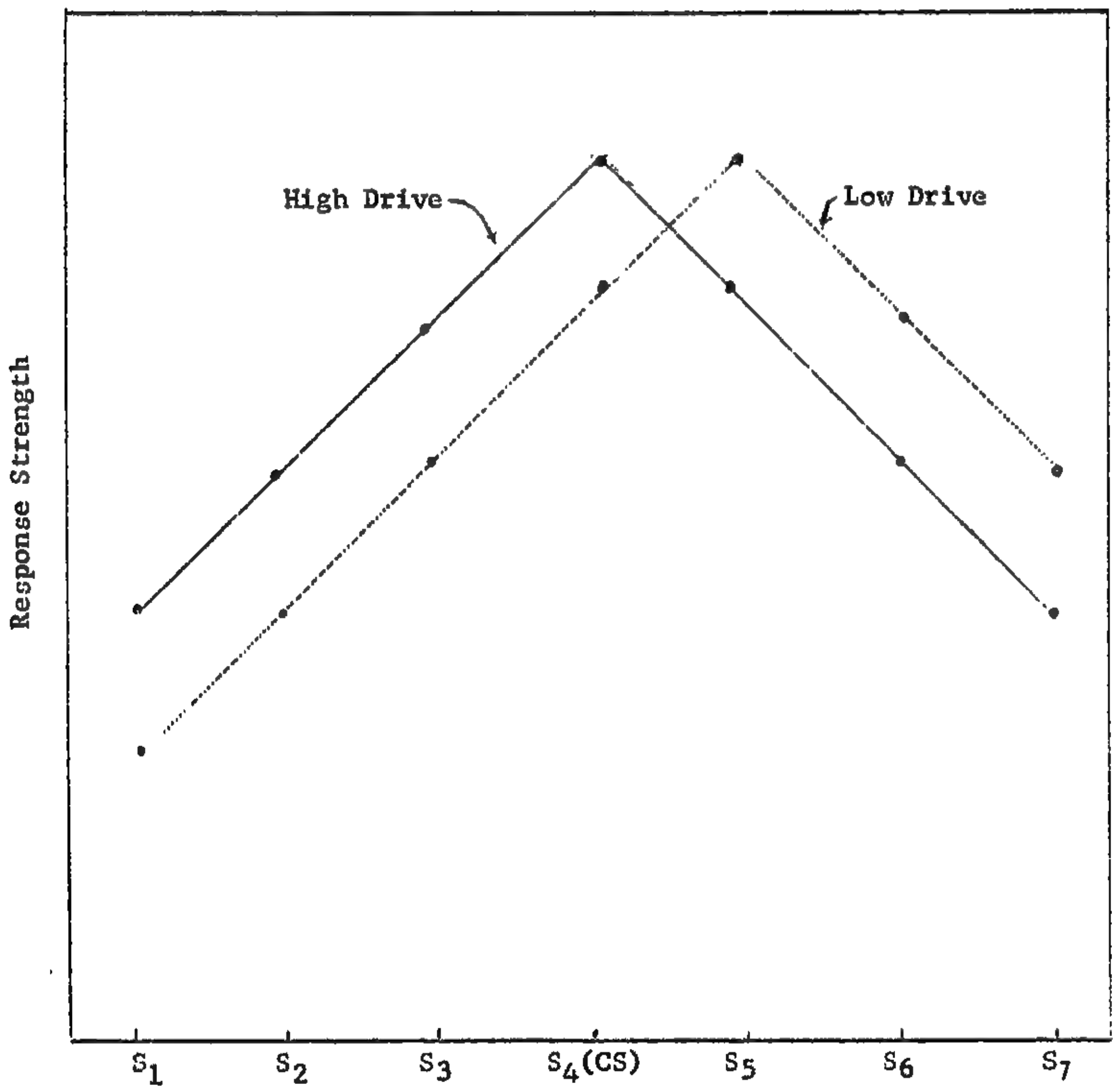

Figure 1

Predicted Testing Generalization Gradients for
Group Trained Under HIgh Drive (Experiment I)

The opposite effect is predicted when we shift from training under low drive to testing under high drive. In this case, all stimului should be perceived as <u>more</u> intense during testing.

Stimuli physically less intense than the CS increase in generalized response strength, while the Cs and stimuli physically more intense than the CS decrease in generalized response strength. The final result is to shift the generalized response curve in the direction of the smaller stimuli. This result is shown diagrammatically in Figure 2.

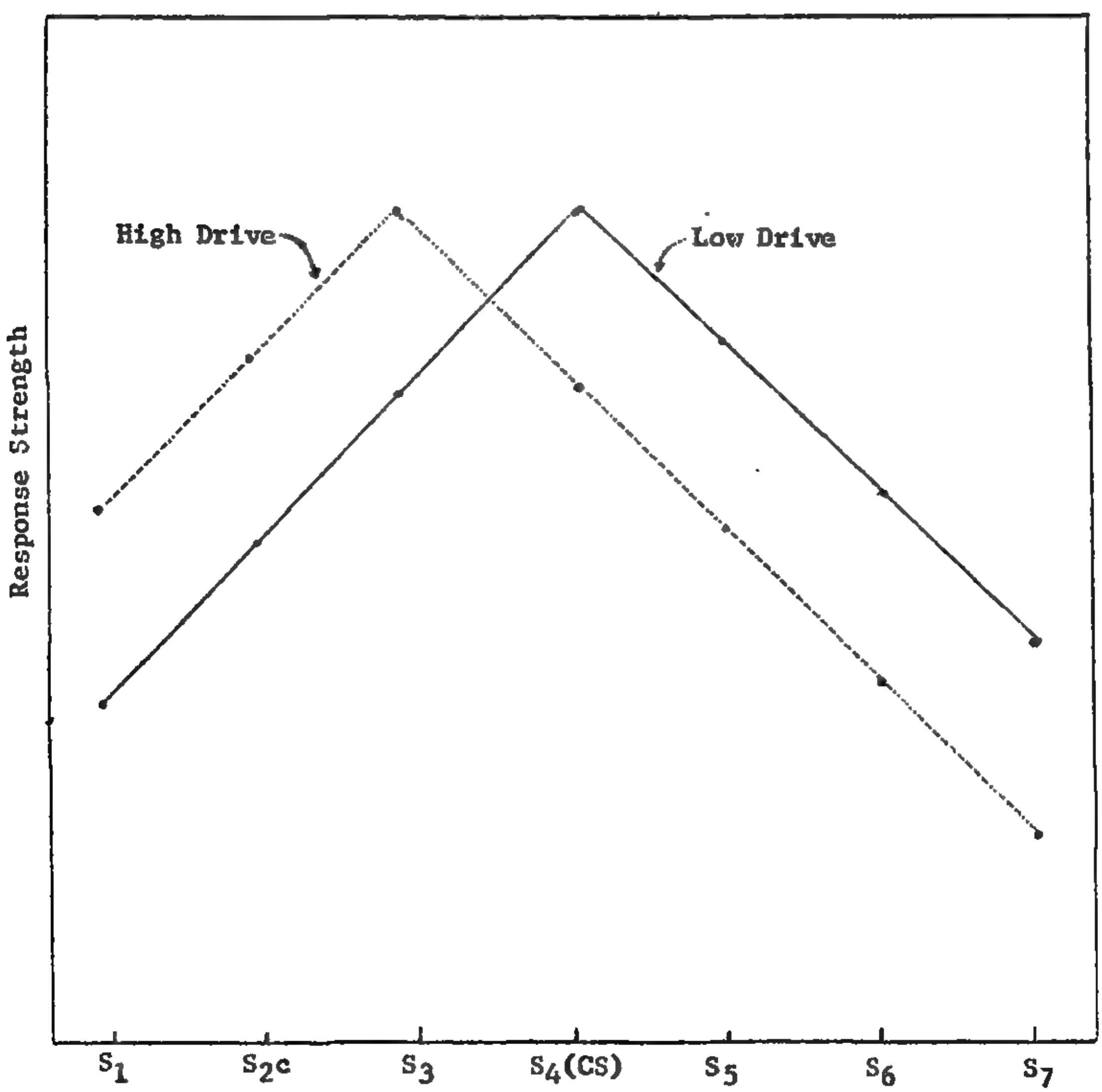

Figure 2

Predicted Testing Generalization Gradients for Group Trained Under Low Drive (Experiment I)

Dorfman (1960) has reported one such behavioral test of the D x S hypothesis. He utilized sounds as drive-producing stimuli, and trained Ss to respond to weak electric shocks. The generalization curves fro both Train Low Drive-Test High Drive and the Train High Drive-Test Low Drive groups shifted significantly in the predicted direction.

The author (1959) carried out a study to assess the effect of incentive (K) on the perceived intensity of shock. During training under high incentive, Ss were informed that they were in a gambling situation and would be paid for each correct response. During testing under low incentive, they were told that they were no longer in a gambling situation, and could not add to or detract from their winnings. The results of this study were similar to those of Dorfman, although the shift was not significant.

The present study differs from the previous ones in several ways. Proprioceptive stimulation, (muscle tension) obtained by means of a spring dynamometer was used as drive. Such tension affects performance much the same as do other drives such as hunger, fear, anxiety, etc. (Courts, 1942a, 1942b), and has the added advantage of being susceptible to turning "on" or "off" at will, unlike other drives, which cannot be so easily manipulated. Also, the training stimuli varied on sound, rather than the shock dimension.

A further implication of the D x S hypothesis can be tested by the investigation of the effects of drive on a pitch rather than loudness dimension. Stevens (1957, 1958) makes a distinction between the prothetic or quantitative, class of stimuli and the

metathetic, or qualitative, class. The former includes "magnitudes like heaviness, loudness, brightness, etc. for which discrimination appears to be based on an additive mechanism by which excitation is added to exitation at the physiological level." The latter includes "pitch, position, etc. for which discrimination behaves as though based on a substitutive mechanism at the physiological level."

One physiological explanation for the effect of drive on perceived intensity is that there is a summation of the neuronal impulses produced by the stimulus with those produced by the drive state. It is generally held (Osgood, 1953) that sounds of differing intensities are perceived differently because of the <u>amount</u> of neural stimulation. Thus if drive interacts with the amount of this simulation, sounds will be perceived as more intense under heightened drive. In the first half of this study (Experiment I), tones were used which differed along a loudness (prothetic; quantitative) dimension. The D x S hypothesis is concerned with the effect of drive on such stimuli; and it is here that we would predict the shifts shown in Figure 1 and 2.

Pitch perception, expecially for tones of medium and high frequency, is apparently a function of the place of excitation within the ear rather than the amount of such exitation (Osgood, 1953). Thus according to the D x S hypothesis, increased drive should make a tone of a given pitch seem louder, but not make it be perceived as having a different pitch. The second half of the study (Experiment II) was designed to test this derivation of the D x S hypothesis. Tones were used which differed along a pitch

(metathetic; qualitative) dimension, as explained above, neuronal summation and, accordingly, the D x S hypothesis is not relevant here. In this case we would predict no consistent shift due to the affect of drive.

EXPERIMENT I (LOUDNESS)

Method

Apparatus

A Hewlett-Packard audio-oscillator was used to produce sounds of various intensitites and pitches. These were presented to S through rubber-cupped earphones. A Stoelting dynamometer was employed to furnish proprioceptive stimulation. A microswitch was attached to the dynamometer, allowing the pointer of the instrument to complete a circuit when the dynamometer had been squeezed with the required force. An electronic timer was used to control the duration of the auditory stimuli.

Subjects

Ss were 40 male students enrolled in an elementary psychology course at The University of Michigan.

Procedure

The training method was similar to that used by Dorfman (1960), an adaptation of a technique used by Brown, Clarke, and Stein (1958). After a maximum value for the S on the dynamometer had been obtained S was read the following.

Instructions

I want you to set the dial at ( ). When I tell you to, squeeze the handle so that the dial moves and throws the switch. Each time this happens, you'll hear a sound through the earphones. There are three different sounds that you can hear. One of these sounds stands for "win," the other two stand for "lose." This is the way we will work it: I'll tell you where to set the dial each time. When you have set it, you'll say "O.K." Then I'll say, "Squeeze." You'll squeeze the handle until you hear the sound in the earphones. Then you'll tell me whether you think it's a "win" or a lose," and I'll say "correct" or "incorrect." In the beginning, of course, you will be just guessing, but after a while you'll learn which sound stands for "win" and which ones stand for "lose." Do you have any questions? All right, is the dial set at ( )? Are you ready? If you get very tired, let me know. Squeeze.

Training

On each trial, (approximately every 20 seconds), S received one of three stimuli, which were approximately equally spaced along a log-intensity continuum. (Decibel levels were: 70 db for Stimulus 1, 77 db for Stimulus 4, and 85 db for Stimulus 7). All tones were 958 cps. The S was given a total of 29 training trials in pre-arranged random order; 8 to Stimulus 1, 13 to Stimulus 4, and 8 to Stimulus 7. S was trained, through feedback, that Stimulus 4 represented "Win" while Stimulus 1 and Stimulus 7 represented "Lose." If S learned very rapidly, the number of trials was reduced to 21. If S failed to learn within 29 trials, training was continued until S reached a criterion of 10 consecutive correct responses. Thus each subject had learned the discrimination before the experiment proceeded.

Ten Ss were trained under the high drive condition. For these Ss, the dynamometer was set before each trial at 2/3 of their previously determined maximum. The ten remaining Ss were trained under the low drive condition. For these Ss, the dynamometer was

set at 1/20 of their maximum.

Testing

After training had been completed, S was read the following directions:

From now on, we'll work this a little differently. There will be two different dial settings. I'll tell you each time where the dial should be set. Sometimes I'll say ( ) and sometimes I'll say ( ). Then you'll say "O.K." I'll say "Squeeze" and you'll squeeze the handle and hear the sound the same as before. The sounds will be the same ones as before. The same sound will stand for "win" and the same two sounds will stand for "lose." Now, however, I won't always tell you whether you're correct or incorrect. Sometimes I will, and sometimes I won't. I will never give you wrong information. Sometimes I just won't give you any information at all. O.K? Do you have any questions? Set the dial at ( ), etc.

S was then presented with a total of 56 testing trials in prearranged random order. These consisted of 4 trials each under high drive, and 4 trials each under low drive, of seven stimuli, approximately equidistantly spaced along a log-intensity continuum. These stimuli were: Stimulus 1 (70db), 2(73db), 3(75db), 4(C.S.-77db), 5(79db), 6(81.5db), and 7(85db). Randomly interspersed among these testing stimuli were 19 additional training (feedback) trials, presented to maintain performance level (6 of Stimulus 1, 7 of Stimulus 4, 6 of Stimulus 7).

In addition, after 24 testing trials had been given, S was read the following statement: "There is a finite number of trials to be completed, and we've now passed the half-way mark. If you get very tired, be sure to let me know."

If subjects reported that they were tired, the high drive value on the dynamometer was reduced to approximately 60% of their maximum.

Results

The graphed results of Experiment I are found in Figures 3, 4, and 5. Figure 3 contains the findings on those Ss trained under high drive and tested under high and low drive. It is evident that the results seem directly opposite to those which had been predicted from the D x S hypothesis.

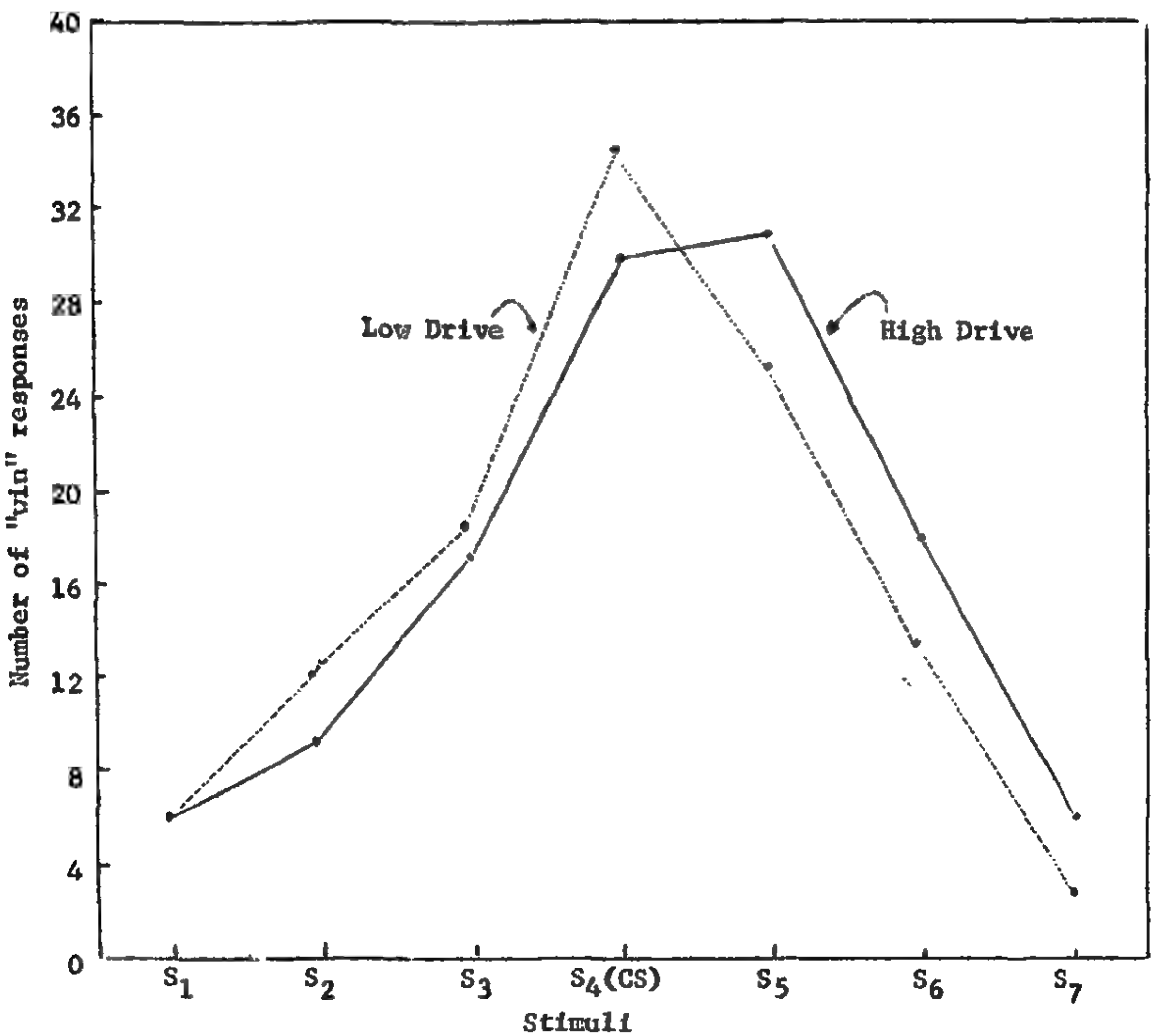

Figure 3

Generalization Gradients for Group
Trained Under High Drive (Experiment I)

Thus, the experimental curve (Train High Drive-Test Low Drive) is to the left of the control curve (Train High Drive-Test High Drive). This is a direct reversal of the predicted results. In other words, subjects trained under high drive and subsequently tested under low drive apparently perceived the sounds received under the low drive condition to be louder than those received under the high drive condition. This fact is reflected in the medians of the two distributions, 4.38 for Train High Drive-Test High Drive vs. 4.06 for Train High Drive-Test Low Drive. The Drive x Stimulus interaction was not statistically significant, however, as can be seen in Table 1, which contains the analysis of variance.

Table 1

Analysis of Variance of Win Responses of Group Trained Under High Drive Condition (Experiment I)

Source	df	MS	F	p
Drive (D)	1	0.18	0.31	NS
Stimulus (St)	6	22.68	20.07	<.001
Subjects (Ss)	9	2.56	4.35	PL.01
D x St	6	0.85	1.44	NS
D x Ss	9	0.39	0.65	NS
St x Ss	54	1.13	1.91	<.01
D x St x Ss	54	0.59	--	--

Figure 4 contains the results obtained on those Ss trained under low drive and tested under high and low drive. Again, these results seem opposite to those which had been predicted. The Train Low Drive-Test High Drive curve is clearly to the right of the

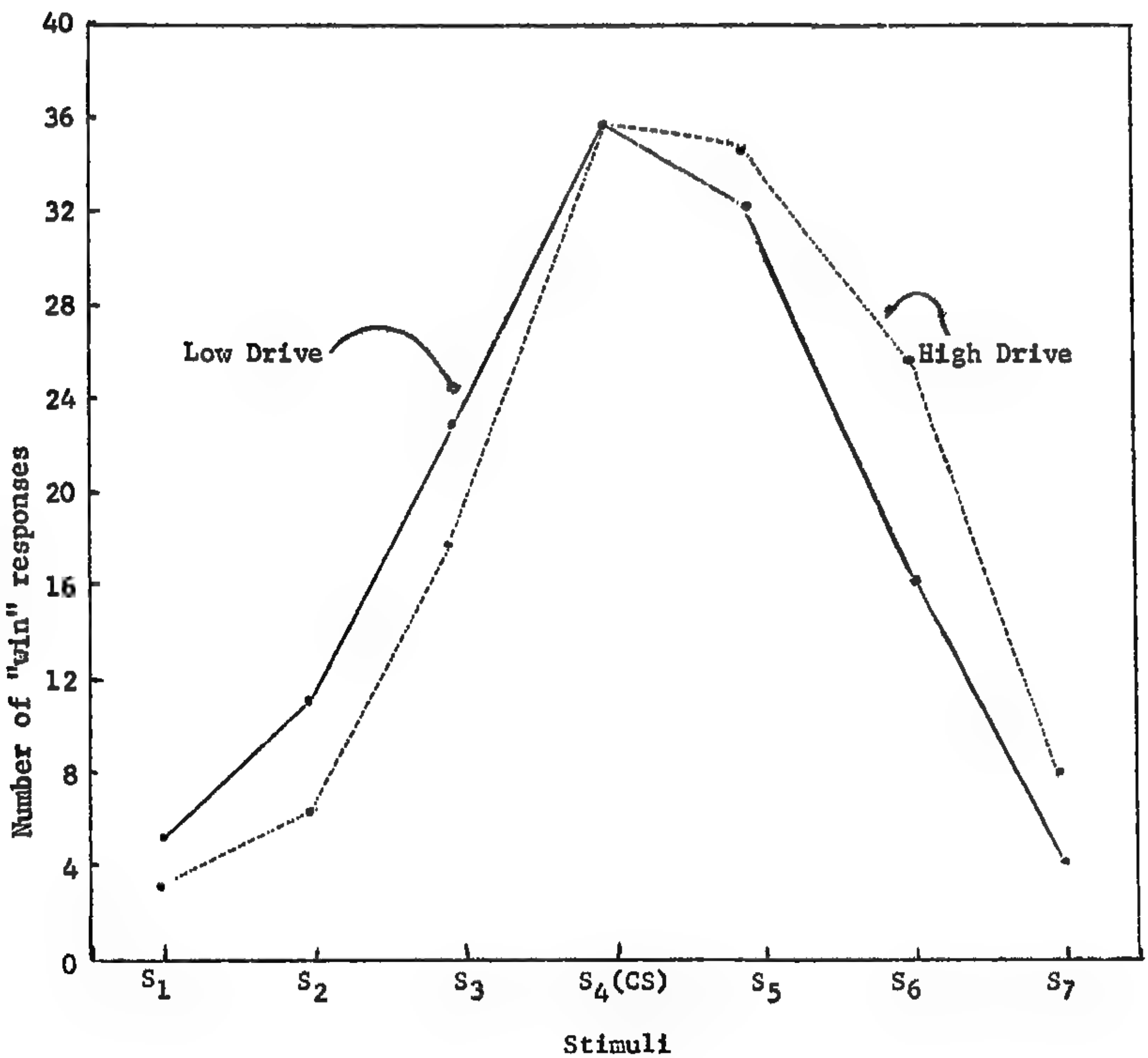

Figure 4

Generalization Gradients for Group Trained
Under Low Drive (Experiment I)

Train Low Drive-Test Low Drive curve, the medians being 4.64 and 4.19 respectively. The D x S Interaction is significant beyond the .05 level (Table 2). This reversal occurs on all points of both graphs, with the exception of two where there is no difference.

Table 2

Analysis of Variance of Win Responses of Group Trained Under Low Drive Condition (Experiment I)

Source	df	MS	F	p
Drive (d)	1	0.11	0.2	NS
Stimulus (St)	6	31.97	30.45	<.001
Subjects (Ss)	9	2.02	3.67	
D x St	6	1.43	2.60	<.05
D x Ss	9	0.18	.33	NS
St x Ss	54	1.05	1.91	<.01
D x St x Ss	54	0.55	--	--

Observation of the graphed data in Figures 3 and 4 also reveals a moderately large difference between the two control curves (i.e., Train High Drive-Test High Drive vs. Train Low Drive-Test Low Drive). These two curves are shown together in Figure 5. The Train High Drive-Test High Drive curve is to the left of the Train Low Drive-Test Low Drive curve. While the Drive x Stimulus interaction is far from significant (Table 3), this difference probably cannot be ignored, since both curves obtained under the low drive condition are to the right of those obtained under the low drive condition. If we combine these data

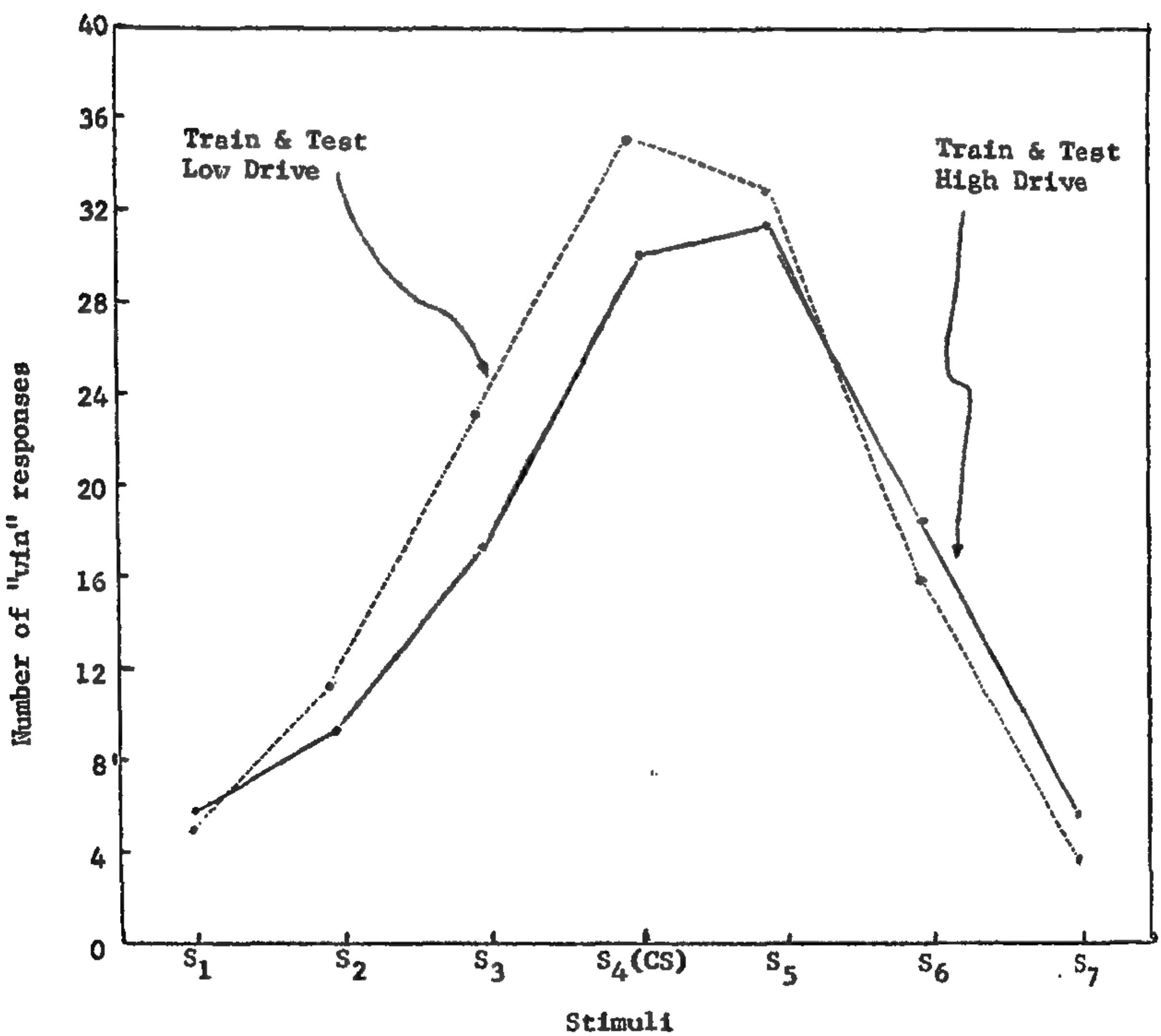

Figure 5

Generalization Gradients for Groups Trained and Tested Under Same Drive Condition (Experiment I)

Table 3

Analysis of Variance of Win Responses of Groups Trained and Tested Under Same Drive Condition (Experiment I)

Source	df	MS	F	p
Between Drive groups	1	.58	--	NS
Between Subjects in same group	18	1.12	--	--
Total between Ss	19	1.09	--	--
Drive x Stimulus	6	.63	--	NS
Stimuli	6	26.13	29.39	<.001
Pooled Interaction	108	0.89	--	--
Total within Ss	120	2.14	--	--

for all Ss tested under low drive and all Ss tested under high drive regardless of training drive the resulting curves (Figure 6), also indicate some difference due simply to drive condition during testing, as opposed to a change in drive condition from training to testing. (See Figure 6 on the following page.)

Discussion

The data failed to confirm the D x S hypothesis (Figures 3 and 4). Accordingly, discussion of Experiment I will consist of several possible explanations of this consistent reversal of the predicted effect.

One possibility is that the D x S hypothesis is simply incorrect. Dorfman's (1960) data, as well as that of the author (1959), support the hypothesis; these results do not preclude the possibility of results being obtained through artifacts or chance.

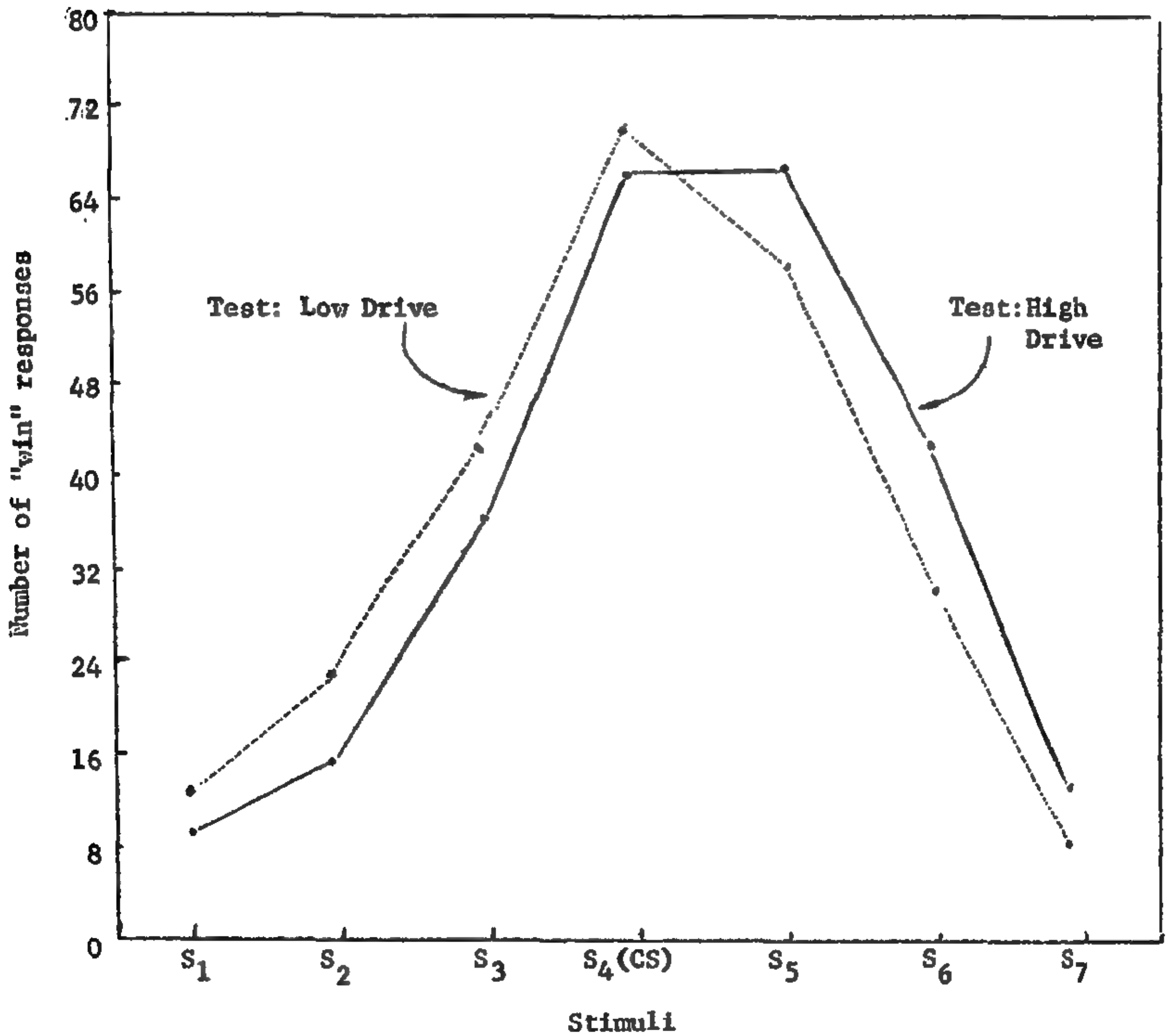

Figure 6

Generalization Gradients for Combined Test High Drive vs. Test Low Drive Groups (Experiment I)

A somewhat more likely possibility is that the D x S hypothesis holds for some stimulus dimensions and some interactions, while it is not applicable, or is reversed for others. The present study is the first to utilize either an auditory stimulus continuum or proprioceptive stimulation as D. Until other proposed research is completed, the applicability of the D x S hypothesis for other drive states and stimulus dimensions remains uncertain.

A related possibility is that there was an undetected weakness in the experimental design and/or procedure. While these were basically the same as those followed previously by Dorfman (1960) and Matlin (1959), there are enough differences to at least suggest that some new factor produced the results obtained.

It is also possible that some sort of attention factor was operating during the experiment. Thus, the effort necessary to throw the switch at 2/3 maximum strength, and the attention needed to bring the pointer the required distance, might have been sufficient to distract S's attention from the sound stimuli. It is conceivable that this lessening of attention would lead to the perception of sounds as less intense. The effort and attention needed to throw the switch at 1/20 maximum were probably minimal. Under this drive condition, attention to the sound stimuli could have been high, resulting in perception of them as more intense. This would then explain the obtained shift.

The Dorfman (1960) and Matlin (1959) studies did not involve manipulation or muscular tension during trials, and in these cases it could be argued that attention was not an important factor.

Weakening this explanation is the fact that sound perception from earphones would seem less susceptible to attention interference than tactual shock stimuli. Despite this, however, the possibility of attention as the key variable cannot be completely ignored.

It seems very possible that there is a curvilinear relationship between drive strength and perceived intensity. Stauffacher, (1937) formulated the hypothesis that there is an amount of tension which is optimal for a given activity, and that amount of tension both above and below this level are not as effective. The data obtained by Courts (1939) and Shaw (1956) support this view. Both studies utilized dynamometers to induce muscular tension, Courts observing learning of syllables and Shaw perception of digits. It is interesting to note that in Courts' experiment, muscular tension led to poorer performance at approximately 2/3 of a standard maximum, the same amount of tension used in the present study. Dorfman (1960) is considering a similar effect when he writes that "It is....possible that a shift toward the larger stimulus might be obtained when drive level is increased to a large extent, and, conversely a shift toward the lesser stimulus intensity when drive level is reduced from an originally very high value."

Similarly, sensory interaction studies supply evidence that drive can have an inhibitory effect under certain circumstances (Jacobson, 1911; Shore, 1958).

The assumption that very strong drive has an inhibitory effect, while moderate drive has a facilitory effect can be

empirically tested. An experiment is now planned in which the low drive condition will be a pull of only 2% maximum, while high drive will be a pull of 35% maximum. If in this case intensity is increased by the high drive and decreased by low drive, we will have convincing evidence that the relation of drive to stimulus intensity is, in fact, curvilinear.

Finally, there are two additional factors which may eventually lead to a unified explanation of the relevant data. The first is the intervening variable stimulus intensity dynamism (V) (Hull, 1952). According to Hull, the magnitude of the stimulus _per se_ (V) combines multiplicatively with drive, habit, strength, etc. to determine reaction potential, i.e., ${}_{S}E_{R}$ = f(D x V x H). Since the experiment deals with stimulus intensity, as well as drive and habit strength, it is not illogical to believe that V is in some way determining the results.

A second supposition perhaps worthy of mention is that since this study deals with discrimination learning, the positive "win" stimulus generalization gradient is not the only effective gradient operating to determine reaction potential. The gradients formed around Stimuli 1 and 7 are undoubtedly exerting an inhibitory effect which also acts to determine reaction potential.

While the author was unable to use either of these factors to explain in a consistent fashion both his data and that of Dorfman's, they are mentioned in the hope that some other investigator may find them helpful in planning further research or constructing a unified theory.

EXPERIMENT II (PITCH)

Method

Procedure

The procedure followed in Experiment II was identical to that of Experiment I, except that the auditory stimuli differed on a pitch, rather than a loudness, continuum. The 7 pitches were chosen on the basis of data obtained from 2 preliminary observers, who judged them to be equivalent in jnd spacing to the corresponding tones on the intensity continuum. These 7 pitches were: Stimulus 1 (892cps), 2(912cps), 3(933cps), 4(C. S. -958cps), 5(975cps), 6(998cps), and 7(1019cps). Due to a peculiarity of the apparatus, the intensity of the 7 pitches was not identical. The loudness values of pitches 1, 4, and 7 were found to be 80db, 79db, and 82db respectively.

Results

The data obtained in Experiment II are far less consistent than those in Experiment I.

The Train High Drive-Test High Drive vs. Train High Drive-Test Low Drive results are shown in Figure 7. Although the position of the modes suggests that the Train High Drive-Test High Drive curve is to the right of the Train High Drive-Test Low Drive curve, actually the median for the Train High Drive-Test High Drive curve (4.15) is smaller (i.e., father left) than that of the Train High Drive-Test Low Drive curve (4.38). The Drive x Stimulus interaction was near significance ($p < .06$), Table 4, but this is apparently due to the fact that the Train

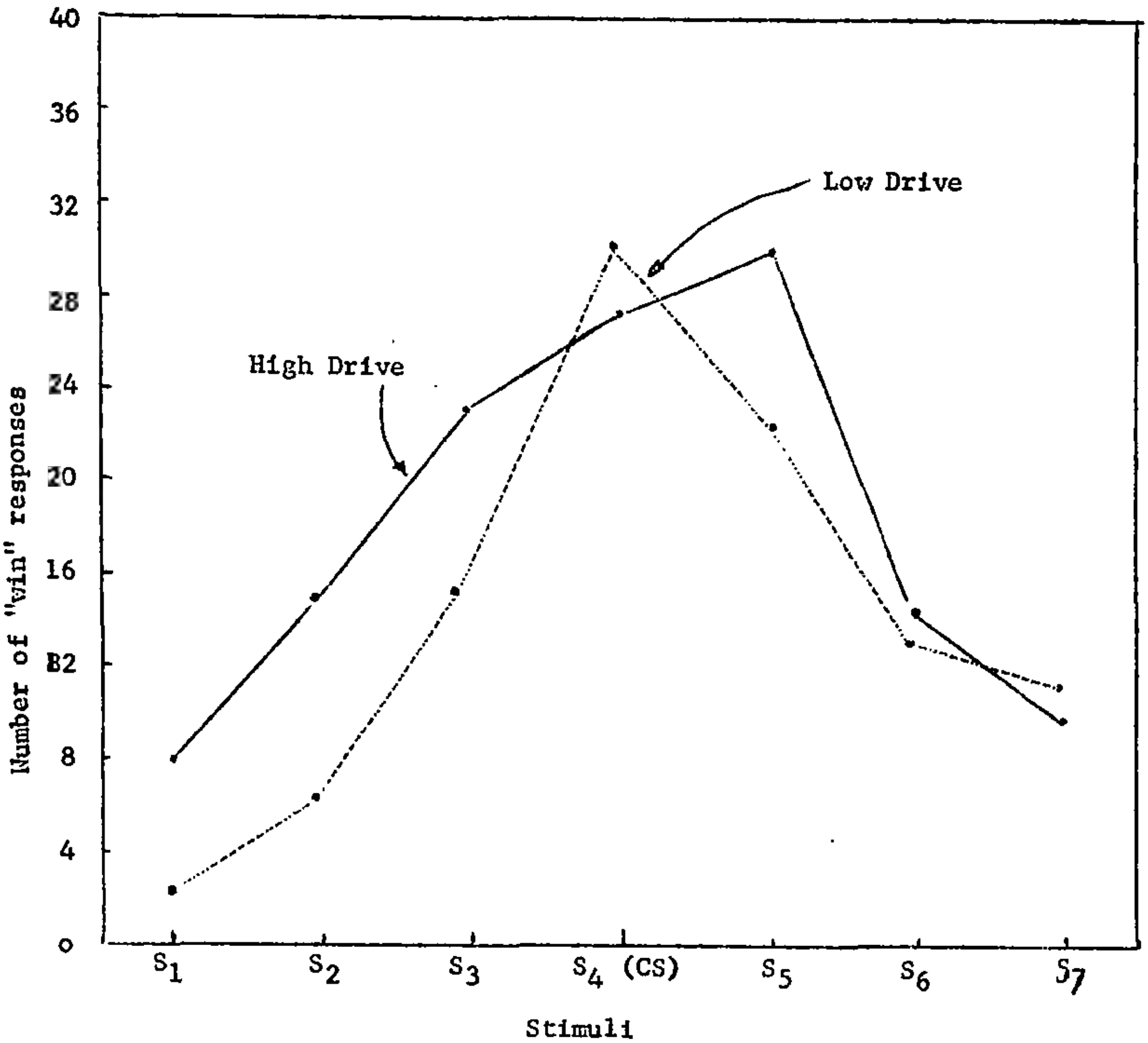

Figure 7

Generalization Gradient for Group Trained Under High Drive (Experiment II)

High Drive-Test High Drive curve is simply higher than the Train High Drive-Test Low Drive curve.

Table 4

Analysis of Variance of Win Responses of Group Trained Under High Drive Condition (Experiment II)

Source	df	MS	F	p
Drive (D)	1	5.60	4.67	<.05
Stimuli (St)	6	15.50	7.08	<.001
Subjects (Ss)	9	3.91	7.38	<.001
D x St	6	1.20	2.20	<.06
D x Ss	9	1.04	1.96	--
St x Ss	54	2.19	4.13	<.01
D x St x Ss	54	0.53	--	--

The data obtained from the subjects trained under low drive and tested under high and low drive is presented graphically in Figure 8. In this case there is some indication of a shift, although the Drive x Stimulus interaction is not significant (Table 5). The medians of the Train Low Drive-Test High Drive vs.

Table 5

Analysis of Variance of Win Responses of Group Trained Under Low Drive Condition (Experiment II)

Source	df	MS	F	p
Drive (D)	1	.46	.62	NS
Stimulus (St)	6	15.28	12.08	<.001
Subjects (Ss)	9	2.51	3.40	
D x St	6	.87	1.18	NS
D x Ss	9	.82	1.12	NS
St x Ss	54	1.27	1.71	<.05
D x St x Ss	54	0.74	--	--

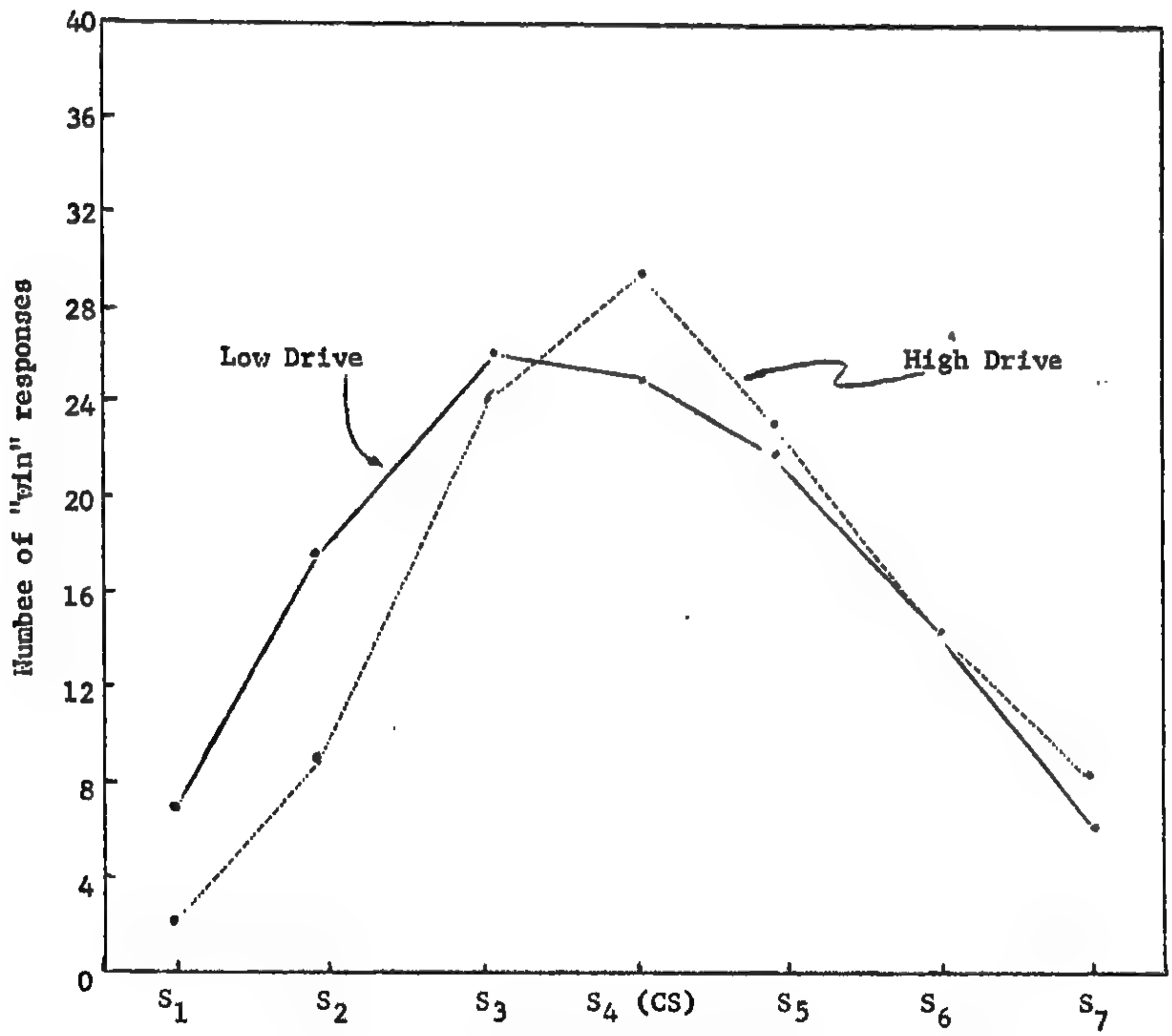

Figure 8

Generalization Gradients for Group Trained
Under Low Drive (Experiment II)

Train Low Drive-Test Low Drive distributions (4.17 and 3.84 respectively) indicate a fairly large degree of divergence; 5 of the 7 points are consistent with the suggestion that the curve has shifted.

The difference between the two control curves (Train High Drive-Test High Drive vs. Train Low Drive-Test Low Drive) appears, by observation, to be large. (See Figure 9 on following page.) When, however, an analysis of variance was performed, (Table 6), there was no significant Drive x Stimulus interaction.

Table 6

Analysis of Variance of Win Responses of Groups Trained and Tested Under Same Drive Condition (Experiment II)

Source	df	MS	F	p
Between Drive groups	1	0.72	--	NS
Between Ss in same groups	18	1.71	--	--
Total Between Ss	19	1.65	--	--
Drive x Stimulus	6	.78	--	NS
Stimuli	6	13.31	10.59	<.001
Pooled Interaction	108	1.26	--	--
Total Within Ss	120	1.84	--	--

The combined data for all subjects tested under high drive, and all those tested under low drive, yielded the two curves found in Figure 10. While the high drive curve is slightly higher for all points, these curves are virtually the same. As would be expected, the medians are almost identical: 4.14 for high drive,

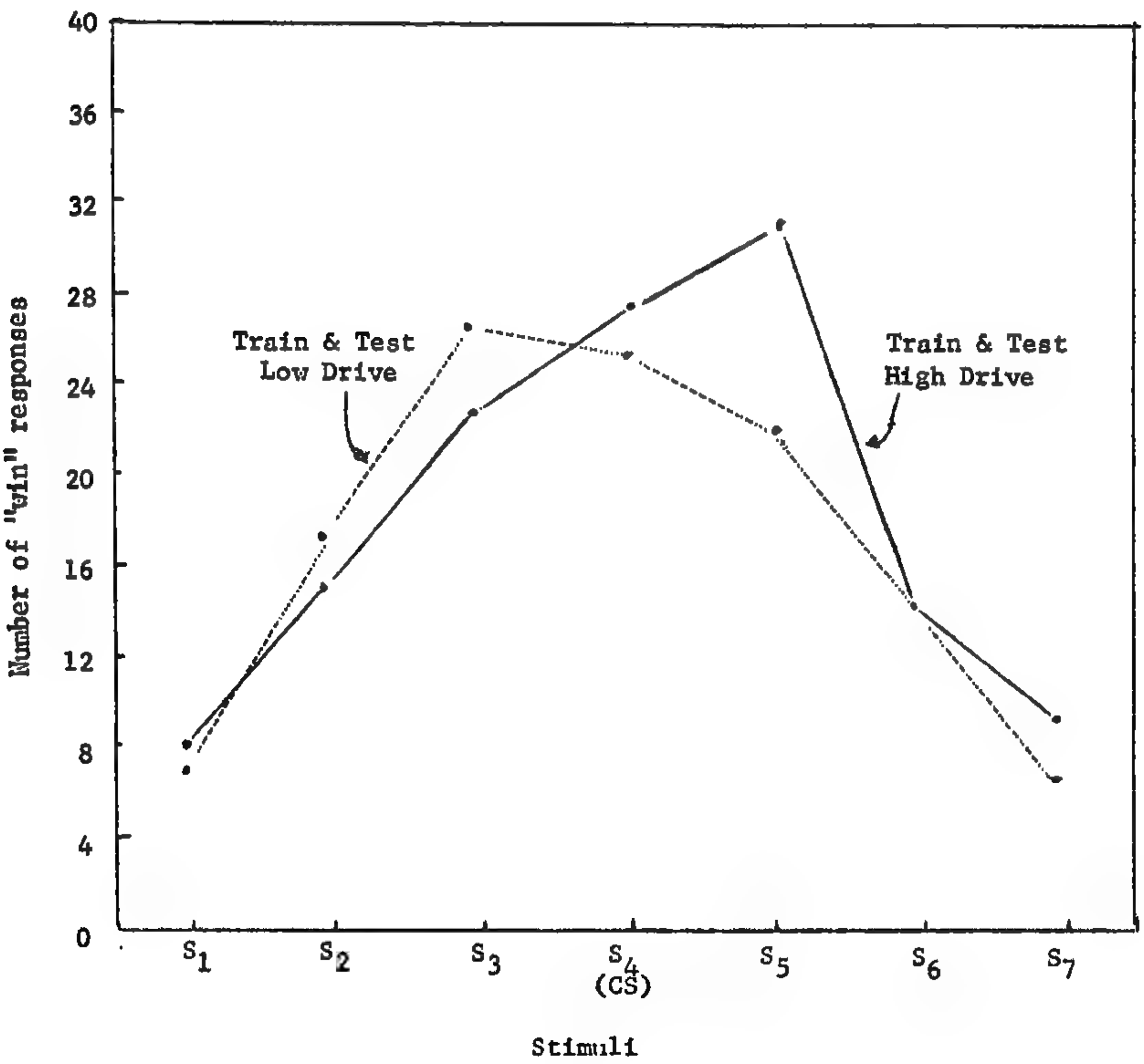

Figure 9

Generalization Gradients for Groups Trained and Tested Under Same Drive Conditions (Experiment II)

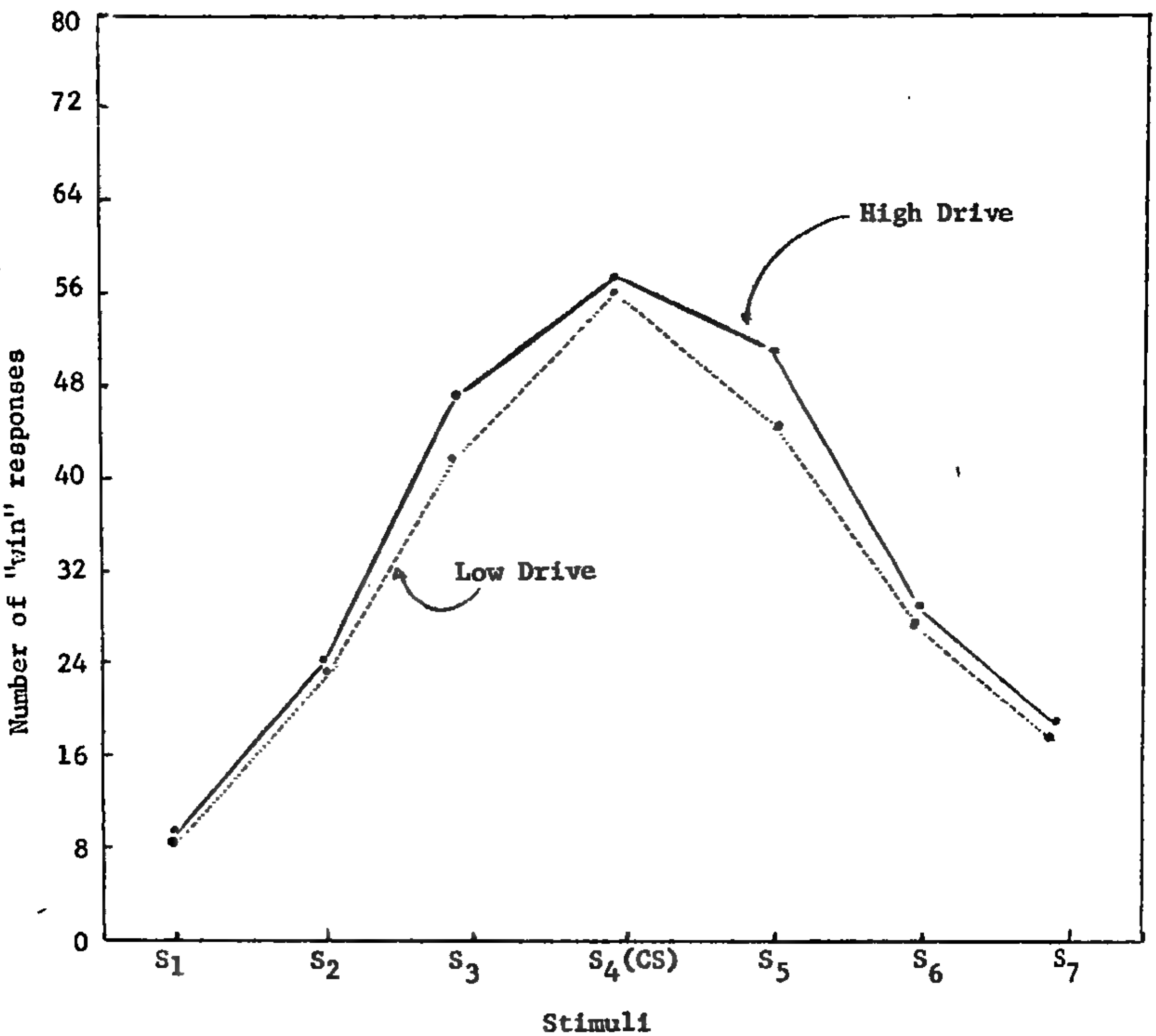

Figure 10

Generalization Gradients for Combined Test High Drive vs. Test Low Drive Groups (Experiment II)

4.12 for low drive. The similarity of these combined curves for pitch is in marked contrast to the difference between the combined intensity curves of Figure 6.

Discussion

The results obtained for the Train High Drive-Test Low Drive group are consistent with the D x S hypothesis. As predicted, for the stimulus dimension of pitch, there was no curve shift. The results are also consistent with the prediction of Estes (1958) that, due to a change in the weight of common cues, the Train High Drive-Test Low Drive curve should be lower and steeper than the Train High Drive-Test High Drive curve.

The Train Low Drive-Test High Drive curve for pitch presents more of a problem. Here we have some indication of a curve shift, which, although not significant, is large enough to warrant further discussion. These data also do not support the prediction of Estes (1958) that the result of a low to high drive change will be the lowering and flattening of the Train Low Drive-Test High Drive curve.

Since the D x S interaction was not significant, one solution is to consider the two curves identical, a finding consistent with the D x S shypothesis. However, it seems unwise to ignore the similarity between these curves and the intensity curves of Experiment I obtained under corresponding drive conditions (Figure 4).

One explanation for these results is that there was an intensity difference as well as a pitch difference between the stimuli.

Another is that some uncontrolled variable is acting in a non-random manner to influence the results.

Comparison of the two control curves (Train High Drive-Test High Drive vs. Train Low Drive-Test Low Drive) and the two combined curves (Test High Drive vs. Test Low Drive disregarding training drive level) shows no significant differences due to drive. These findings support the hypothesis that the effect of drive on the relative position of stimulus generalization gradients is not an important factor when dealing with this qualitative stimulus dimension.

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